Rec'd PCT/PTO 14 JAN 2005
PCT/SE2003/001074
10/521653

A device in a vehicle adapted to handle loads.

FIELD OF THE INVENTION AND PRIOR ART

The invention concerns a device for a vehicle intended for handling loads, such as an industrial truck, comprising a movable arm connected to the vehicle, to which a tool intended to carry a load is connected, and an arrangement to control movements of said tool.

Vehicles intended for handling loads exist in many different forms, including for example digging machines, tractors, so-called front-loaders and industrial trucks. Such vehicles can either be driver-controlled or driver-less, remote controlled. The invention is suitable for all types of vehicles intended for handling loads, but is particularly suitable for vehicles of the truck type, such as an industrial truck for example, i.e. a vehicle which is used in warehouses, at industrial sites, loading yards and such for handling loads. For this reason the invention will subsequently mainly be described in connection with vehicles of such truck type without this limiting the invention to such vehicles.

It is known to provide the above-mentioned type of vehicle with devices mentioned in the introduction for handling loads. For example it is known to equip an industrial truck with a fork tool, which is raisable and lowerable on a substantially vertical lifting mast arranged on the vehicle. Such a device does not however

allow the movement of the tool in the horizontal direction relative to the vehicle, which results in that the whole vehicle has to be moved in the horizontal direction when such a movement of the tool is desired.

SUMMARY OF THE INVENTION

The aim of the invention is to develop devices of the type mentioned in the introduction to make improved movement patterns of the tool included in the device possible and thereby to achieve a more flexible handling of the load.

This aim is achieved according to the invention by providing a device of the said type, in which
- the arm is pivotably mounted on the vehicle about a first substantially horizontal axis,
- the device comprises a member for pivoting the arm relative to a chassis of the vehicle,
- the tool is displaceably arranged relative to the chassis of the vehicle in the direction of the arm's main longitudinal extension,
- the device comprises means for displacing the tool,
- the control arrangement is designed to co-ordinate the pivoting member's pivoting of the arm and the displacement means' displacement of the tool to achieve a movement of the load carried by the tool along an optionally placed curve having an optional appearance in relation to the vehicle in the vertical plane.

With such a device a more flexible handling of loads is accordingly possible, where the load can be moved along an optional curve in the vertical plane. The term "curve" even includes straight lines in this description and the attached claims, since a straight line may be considered to be a curve with an infinite radius of curvature. A load can therefore for example be moved heightwise to an optional constant distance from the vehicle, whereby the arm's maximum length restricts the maximum distance from the vehicle. Likewise it is possible to move the load

in the horizontal direction relative to the vehicle to an optional constant height over the ground on which the vehicle is placed using the device. The flexibility in handling the load which is provided by the inventive device allows extensive movement of the load while the vehicle is stationary, which for example is very advantageous where space is relatively restricted. Furthermore the tool's movement patterns make it possible to access loads positioned in hard to access places. For example it is possible to drive the tool a long way into the loading space of a railway wagon, on a truck bed or such to collect or deliver loads there.

According to a preferred embodiment of the invention the tool is pivotably arranged relative to the arm about a second substantially horizontal axis, where the device comprises means for pivoting the tool relative to the arm and the control arrangement is designed to control the pivoting means' pivoting of the tool for adjustment of the tool's orientation. By adjusting the tool's orientation it is accordingly possible to adjust the load's orientation as desired.

According to another preferred embodiment of the invention the control arrangement is designed to co-ordinate the pivoting means' pivoting of the tool with the pivoting member's pivoting of the arm and with the displacement means' displacement of the tool to achieve a desired, ordered orientation of the tool during its movement.

In this way the tool can accordingly be adjusted to assume such an orientation during movement, which remains constant or varies during the movement, so that the load carried by the tool has the desired orientation at each point in time during the movement.

According to another preferred embodiment of the invention the control arrangement is designed to co-ordinate said pivoting

movements and displacements to maintain a substantially constant orientation of the load carried by the tool when moving the load. It follows from this that it is necessary that said second horizontal axis is parallel aligned with said first horizontal axis. Due to the design of the control arrangement it is accordingly possible to move the load along an optional curve in the vertical plane while maintaining the load's orientation. This reduces the risk of releasing the load from the tool during movement inter alia.

According to another preferred embodiment of the invention the tool is connected to the arm via an arrangement for replaceable attachment of tools to the arm. It is subsequently possible to change the tool for adaptation to the load that is to be handled.

According to another preferred embodiment of the invention the arm is connected to the vehicle on one longitudinal side of the vehicle in its normal driving direction. The arm is therefore positioned so that it does not result in an impairment of the view of the driver of the vehicle.

Further advantages, advantageous features and fields of use of the invention are apparent from the other dependent claims and the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention are described as examples in the following description with reference to the attached drawings, in which:

Fig 1 is a side view of a device on a vehicle intended for handling loads according to a first embodiment of the invention,

Figs 2-6 are side views of the device shown in Fig 1 schematically illustrating different movement patterns that are possible to achieve with a device of the inventive type,

Fig 7 is a side view of the device shown in Figs 1-6 schematically illustrating the carrying of a load in a possible position relative to the vehicle, and

Fig 8 is a perspective view of a device on a vehicle intended for handling loads according to a second embodiment of the invention, shown diagonally from the front, partly in cross-section.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

Fig 1 illustrates a device on a vehicle intended for handling loads according to a first embodiment of the invention. The vehicle 1 illustrated in all of the figures is an industrial truck with a driver's seat F, a chassis 2 and wheels 3 connected to the chassis in the vicinity of each corner of a rectangle in the horizontal plane, where, for example, two are individually controllable to drive the vehicle forward and all four wheels are, for example, individually controllable to control the vehicle. As already pointed out in the introductory part, this type of vehicle is only one possible type of vehicle to which the invention can be applied and consequently any other types of vehicle can be used.

The device comprises a movable arm 4 connected to the vehicle 1 to which a tool 5 intended to carry a load is connected. The tool can be any type of tool or instrument, where the choice of tool is suitably made on the basis of what kind of load is to be handled. For example tools in the form of a gripping tool, holding device, scoop or such can be used. The tool 5 illustrated in

Fig 1 is a fork tool having two forks, which, as illustrated in Fig 1, is well suited to handling a load L placed on a so-called loading pallet 6.

The arm 4 is pivotably mounted on the tool about a first substantially horizontal axis 8. According to the embodiment of the invention as illustrated in Fig 1, the axis 8, about which the arm 4 is pivotable, is arranged on the rear end of the vehicle in the vehicle's normal driving direction.

The inventive device also comprises means to pivot the arm 4 relative to the vehicle's chassis 2 about axis 8. The pivoting means can for example include different types of motors, such as electric motors, adjusting means and such to provide said pivoting. However the pivoting means advantageously includes hydraulic drive means, such as a hydraulic motor or hydraulic cylinder. According to the embodiment of the invention illustrated in Fig 1 this hydraulic drive means is arranged in the form of a hydraulic cylinder 9 that is connected to the vehicle's chassis 2 and to the arm 4.

One end 11 of the piston rod 10 of the hydraulic cylinder 9, is pivotably connected to the arm 4 via a fastening member 12 and pivotably connected to the chassis 2 at a schematically indicated fastening point at 13. By controlling the hydraulic cylinder, the arm 4 can therefore be brought to pivot about the axis 8.

The tool 5 is displaceably arranged relative to the chassis 2 of the vehicle in the direction of the arm's 4 main longitudinal extension and the device comprises means 17 for displacement of the tool. Advantageously the arm 4 has an elongated beam-like configuration, as illustrated in Fig 1. The displaceability of the tool in the embodiment illustrated in Figs 1-7 is realized by the fact that the arm includes at least two parts 14, 15, 16 that are displaceable in relation to each other along the arm's main longitudinal extension, where the tool is connected to a first 16

of the displaceable parts and a second 14 of the displaceable parts is connected to the vehicle's chassis 2, and the displacement means 17 is arranged to displace the arm's first and second displaceable parts 16, 14 in relation to each other for displacement of the tool 5 relative to the vehicle's chassis 2. According to the embodiment illustrated in Figs 1-7 the displaceable arm parts 14, 15, 16 are telescopically received in each other and displaceable relative to each other. Figs 1-7 illustrate that the arm 4 has three displaceable parts 14, 15, 16, but it is possible to use two parts or more than three parts as desired.

The displacement means can for example be arranged in the form of different types of motors which are arranged to displace the parts 14, 15, 16 in relation to one another. However, according to the embodiment illustrated in Figs 1-7, the displacement means includes a hydraulic drive means, preferably a hydraulic cylinder, that is schematically indicated by point 17. One end of the hydraulic cylinder is hereby connected to the arm part 14 and its other end, for example one end of the hydraulic cylinder's 17 piston rod, is connected to arm part 16. By controlling the hydraulic cylinder 17, the arm's 4 length can therefore be adjusted by displacement of parts 14, 15, 16 relative to one another, whereby the tool 5 connected to the arm part 16 is displaced relative to the vehicle's 1 chassis 2.

Furthermore the device comprises an arrangement, schematically indicated at point 7, to control movements of the tool 5. The control arrangement 7 is designed to co-ordinate the pivoting member's 9 pivoting of the arm and the displacement means' 17 displacement of the tool so as to achieve a movement of the load carried by the tool 5 along an optionally placed curve having an optional appearance in relation to the vehicle in the vertical plane.

The control arrangement 7 includes, for example, a programmable computer, that can be reprogrammed if necessary. The device in such a case even preferably comprises means to detect the arm's 4 angle relative to the chassis 2 and means to detect the tool's 5 displacement relative to the chassis, to send these detected values to the control arrangement 7, that is suitably arranged to calculate suitable control signals based on these values and send suitable control signals to the pivoting means 9 and displacement means 17 so as to achieve the desired movement of the tool 5 and thereby the desired movement of the load carried by the tool 5.

Operating devices such as, for example, one or more control levers, steering wheels, knobs or such can be arranged at the driver's seat F of the vehicle 1 to allow the operator to feed in desired movements of the tool 5, whereby signals corresponding to that input are sent to the control arrangement 7 to co-ordinate the arm's 4 pivoting and the tool's 5 displacement in accordance with the input to achieve the desired movement of the tool 5.

In known types of devices for vehicles for handling loads it is known to arrange operating devices to move the tool for carrying the load in one or more directions. The power means that control the tool's movement are thereby usually controlled by the operating devices.

A great advantage with the inventive device as compared with the prior art lies in the fact that the co-ordination of the pivoting means' 9 pivoting of the arm 4 and the displacement means' 17 displacement of the tool 5 takes place at the control arrangement 7. It is therefore possible to feed in the desired movement of the tool 5 and the load carried thereupon via suitable input means, such as for example the above-mentioned operating devices, whereupon the control arrangement 7 then takes care of said co-ordination to achieve the desired movement of the tool. The operator of the device therefore avoids troublesome manual

co-ordination of the movements in different directions with different pivoting means, displacement means and such to achieve the desired movement of the tool, for example, via a large number of operating devices.

Fig 2 illustrates some of the movement patterns, which are possible to achieve using a device of the inventive type. For example it is possible to move the tool 5 and thereby the load carried by the tool 5, along an arched curve such as that which is indicated with line 18. It is even possible to move the tool 5 along different straight lines, such as for example along line 19 to move the tool in a vertical direction, i.e. to raise and lower the tool 5 relative to the vehicle's chassis 2 and thereby relative to the ground 20 on which the vehicle 1 is placed. This raising movement of the tool 5 can for example be carried out above the vehicle 1, as illustrated in Fig 2, or at an optional distance d horizontally from the vehicle 1, i.e. at an optional distance in front of the vehicle in its normal driving direction, as illustrated in Figs 4 and 5.

Furthermore a straight-line movement of the vehicle 5 horizontally at a constant height h over the ground 20 on which the vehicle is placed is possible, as illustrated in Fig 6.

Even optional combination of the movement patterns described above is of course possible to achieve with an inventive device.

The excellent flexibility of the movements of the tool 5 and thus the positioning of the load L carried by the tool 5 makes it possible, for example, to transport the load L with the vehicle 1 while the load L is positioned directly above the vehicle, which is synonymous with above the driver's seat F in the vehicle illustrated in Figs 1-7, as illustrated in Fig 7. This is for example particularly advantageous in situations where space is limited, which is often the case in warehouses and such.

The tool 5 is advantageously pivotably arranged relative to the arm 4 about a second substantially horizontal axis 21. The tool's 5 pivoting movement about axis 21 is indicated with arrows I and II in Fig 1 and with an arrow III in Fig 3. According to the embodiment illustrated in Figs 1-7, the axis 21 is arranged on a member 24 that is at an angle to the arm's 4 main longitudinal extension. Furthermore the device advantageously comprises means to pivot the tool relative to the arm 4. The control arrangement 7 is therefore suitably designed to control the pivoting means' pivoting of the tool 5 to adjust the tool's orientation, i.e. the orientation of the tool's angle relative to the horizontal plane, which in the preceding embodiment can be equated with an adjustment of the angle of the fork tool's 5 forks 22 relative to a horizontal plane.

The control arrangement is preferably arranged to co-ordinate the pivoting means' 23 pivoting of the tool 5 with the pivoting means' 9 pivoting of the arm and with the displacement means' 17 displacement of the tool so as to achieve a desired ordered orientation of the tool during its movement. The orientation of the tool can thereby for example be ordered via the above-mentioned operating devices.

According to the embodiment of the present invention illustrated in Figs 1-7 the control arrangement 7 is arranged to co-ordinate said pivoting movements and displacement movements, i.e. the pivoting means' pivoting of the tool, the pivoting means' pivoting of the arm and the displacement means' displacement of the tool, to maintain a substantially constant orientation of the load carried by the tool during the movement of the load. In other words the load carried by the tool 5 can maintain a substantially constant angle relative to the horizontal plane, which, for example, can be the ground 20 on which the vehicle is located as illustrated in the diagrams, under movement, due to the pivoting means' pivoting of the tool relative to the arm.

The pivoting means can for example comprise different types of motors, such as electric motors, adjusting means and such to provide said pivoting of the tool 5. However, the pivoting means preferably includes a hydraulic drive means, such as a hydraulic motor or a hydraulic cylinder for example. According to the embodiment of the invention illustrated in Figs 1-7 the hydraulic drive means is arranged in the form of a hydraulic cylinder 23. The hydraulic cylinder 23 is connected to the arm 4 via the member 24 and is pivotably connected to a fastening element 26, by the end 25 of its piston rod, and the fastening element is pivotable about axis 21. By controlling the hydraulic cylinder the desired pivoting of the tool 5 relative to the arm 4 is accordingly achieved.

According to the embodiment of the invention illustrated in Figs 1-7 the arm 4 is connected to the vehicle 1 on one longitudinal side of the vehicle in the vehicle's normal driving direction. The arm 4 does not hereby constitute any limitation of the forward view of a driver of the vehicle 1 when driving the vehicle forwards in its normal driving direction, which has otherwise been a problem in known industrial trucks, that have a substantially vertical lifting mast, for raising and lowering the tool, placed in a view-impairing position directly in front of the driver's seat.

Fig 8 illustrates a device for a vehicle intended for handling load according to a second embodiment of the invention. The only thing that differentiates the embodiment according to Fig 8 from the embodiment discussed with reference to Figs 1-7 is the placement of the arm 4, which according to the embodiment in Fig 8 is placed at the other longitudinal side of the vehicle as seen in its normal driving direction compared with the embodiment according to Figs 1-7.

With reference to the embodiment shown in Fig 8 the tool's 5 attachment to the arm 4 will now be explained, but it is to be

understood that the following description is even applicable to the embodiment according to Figs 1-7.

The tool 5 is according to the embodiments of the invention illustrated in Figs 1-8 connected to the arm via an arrangement 27 for attaching tools. The arrangement 27 is preferably an arrangement for replaceable attachment of tools to the arm 4, more particularly in the vicinity of the arm's 4 free end that is distant from the vehicle's chassis 2 and which is freely movable by pivoting the arm 4 about axis 8, to make replacement of the tool 5 possible with the aim of adapting the tool according to the type of load that will be handled.

The arrangement 27 is arranged in the vicinity of the arm's 4 free end that is distant from the vehicle's chassis 2 and comprises a member 24 connected to said end of the arm arranged to extend towards the vehicle's centre as seen in its normal driving direction to maintain an attaching point, schematically indicated at point 29, for the tool at the attaching arrangement substantially centered relative to a horizontal longitudinal axis of the vehicle in said normal driving direction through the vehicle's centre of gravity. In this way the handling of a load centered in front of the vehicle relative to a horizontal longitudinal axis of the vehicle is therefore possible, even though arm 4 is located on a longitudinal side of the vehicle as seen in the normal driving direction.

The invention is of course not in any way limited to the preferred embodiments described above, but a large number of modification possibilities thereof should be apparent for the average person skilled in the art without departing from the basic idea of the invention, as defined in the attached claims.

As regards the use of the words "horizontal" and "vertical" in this document in relation to the vehicle, its structure and control, these directions are applicable when the vehicle is resting on

horizontal ground, and axes and such are of course differently oriented when driving on sloping ground or over obstructions.

It is possible to arrange each of the above-described hydraulic cylinders 9, 17, 23 with its own hydraulic system or with a common hydraulic system to control the hydraulic cylinders and thereby control movements of the tool 5 and thereby the carried load related with each respective cylinder.